EGU24-15357, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-15357
EGU General Assembly 2024

Urban Heat Island under Climate Change over European cities: Evaluation of the EURO-CORDEX ensemble performance in reproducing the UHI

Eloisa Raluy-López[1], Victoria Gallardo[1], Pedro Jiménez-Guerrero[1,2], and Juan Pedro Montávez[1]
[1]Physics of the Earth, Regional Campus of International Excellence (CEIR) "Campus Mare Nostrum", University of Murcia, Spain
[2]Biomedical Research Institute of Murcia (IMIB-Arrixaca), Spain

The urban heat island (UHI) is defined as the temperature difference between a city and its rural surroundings. It is one of the most studied urban phenomena and can have potential adverse effects on human well-being. Furthermore, the UHI may contribute to an increase in the urban energy consumption and ecological footprint, potentially exacerbating the impacts of climate change. The aim of this study is to evaluate the capability of different regional models from the EURO-CORDEX ensemble to accurately reproduce the UHI over several European large cities. Subsequently, the evolution of the UHI under climate change scenarios is studied using the models that demonstrate good performance.

The employed data were extracted from the EURO-CORDEX EUR-11 project and the ERA5-land dataset. The historical data cover the period 1971-2000. The future model data under the climate change RCP8.5 scenario are divided into near future (2021-2050) and distant future (2071-2100) periods. There are multiple ways to perform the UHI intensity calculation. In this case, the urban temperature of each city is assigned as the temperature series of the most urbanized grid point. The reference rural temperature is defined as the mean temperature series of all the valid rural points inside a 1º box centered in the most urbanized point. A rural point is considered to be valid if its rural fraction falls below 5%, its land fraction is no lower than 50% and if its altitude does not differ more than 100 meters from the urban point altitude.

The results of this study show that several models do not simulate the timing of the UHI correctly, exhibiting its daily maximum during the daytime instead of the nighttime, as seen in other studies. ERA5-land data present similar limitations. However, the RegCM4-6 and HadREM3-GA7-05 models are two examples of regional models able to successfully reproduce the UHI effect and its annual and daily cycles. The differences between the historical and future mean annual cycles of the UHI daily maximum show small to no changes in most of the cities, with these small differences being generally negative. Barcelona and Lisbon present greater negative changes, with a reduction of the UHI intensity of around 0.2 ºC in the near future and a reduction of around 0.4 ºC in the distant future. In contrast, Porto and Toulouse present positive differences with an intensification of the UHI effect of around 0.3-0.4 ºC in the distant future. Furthermore, the greatest changes in each city

occur during the summer season. No important changes in the hourly distribution of the UHI daily maximum are found. In conclusion, the UHI effect seems to generally not aggravate the rising temperatures due to climate change in urban areas.

The authors acknowledge the ECCE project (PID2020-115693RB-I00) of the Ministerio de Ciencia e Innovación/Agencia Estatal de Investigación (MCIN/AEI/10.13039/501100011033). ERL thanks her predoctoral contract FPU (FPU21/02464) to the Ministerio de Universidades of Spain.